CLAIMS:

What is claimed is:

1. A plasma processing system, comprising:

a monitoring assembly comprising a multiplexer and signal processor, wherein a first path in the multiplexer is used to provide RF power from a RF source to a plasma generating component in a plasma chamber, the first path comprising a matching network coupled between the RF source and the plasma generating component, and wherein a second path in the multiplexer is used to monitor RF power reflected from the plasma chamber, the second path comprising a filter assembly coupled between the plasma generating assembly and the signal processor.

2. The improved plasma processing system as claimed in claim 1, wherein the signal processor comprises a down converter coupled to the filter assembly for converting a RF signal to a IF signal, an A/D converter for converting the IF signal to a digital signal, and a processor for processing the digital signal.

3. The improved plasma processing system as claimed in claim 1, wherein the down converter comprises a tunable front-end for converting at least one harmonic frequency to the IF signal.

4. The improved plasma processing system as claimed in claim 1, wherein the RF source provides RF power at a fundamental frequency and the filter assembly comprises a high pass filter that attenuates reflected RF power at the fundamental frequency.

5. The improved plasma processing system as claimed in claim 1, wherein the RF source provides RF power at a fundamental frequency and the filter assembly comprises a plurality of band pass filters, each bandpass filter passing reflected RF power at one harmonic of the fundamental frequency and attenuating reflected RF power at the fundamental frequency and other harmonic frequencies.

6. The improved plasma processing system as claimed in claim 5, wherein the signal processor comprises a plurality of down converters, each down converter coupled to one of the bandpass filters for converting a harmonic signal to a IF signal, an A/D converter for converting the IF signal to a digital signal, and a controller for processing the digital signal.

7. The improved plasma processing system as claimed in claim 6, further comprising a switch between the plurality of down converters and the A/D converter.

8. The improved plasma processing system as claimed in claim 5, wherein the signal processor comprising a plurality of down converters, a plurality of IF bandpass filters, a plurality of control modules, a plurality of A/D converters, and a processor, wherein each down converter is coupled to one of the multiplexer bandpass filters for converting a harmonic signal to a IF signal, an IF bandpass filter is coupled to each down converter, a control module is coupled to each IF bandpass filter, an A/D converter is coupled to each control module for converting the IF signal to a digital signal, and the processor is coupled to the plurality of A/D converters for processing digital signals.

9. The improved plasma processing system as claimed in claim 5, the signal processor comprising a plurality of V/I probes, a plurality of A/D converters, and a controller, wherein each V/I probe is coupled to one of the multiplexer bandpass filters for converting a harmonic signal to a voltage signal and a current signal, an A/D converter is coupled to each V/I probe for converting the voltage signal to a digital signal, another A/D converter is coupled to each V/I probe for converting the current signal to a digital signal and a controller is coupled to the plurality of A/D converters for processing digital signals.

10. The improved plasma processing system as claimed in claim 1, wherein the RF source provides RF power at a fundamental frequency and the filter assembly comprises:

a bandpass filter, the bandpass filter passing reflected RF power at the second harmonic of the fundamental frequency and attenuating reflected RF power at the fundamental frequency and other harmonic frequencies, and

a highpass filter, the highpass filter passing reflected RF power at frequencies higher than the second harmonic of the fundamental frequency to the signal processor and attenuating reflected RF power at the fundamental frequency and the second harmonic frequency.

11. The improved plasma processing system as claimed in claim 10, wherein the monitoring assembly further comprises:

a load coupled to the bandpass filter and the signal processor, the load absorbing the reflected RF power at the second harmonic of the fundamental frequency;

a power divider coupled to the highpass filter; and

a plurality of band pass filters, each bandpass filter passing reflected RF power at a harmonic frequency above the second harmonic frequency to the signal processor and attenuating reflected RF power at the other harmonic frequencies.

12. The improved plasma processing system as claimed in claim 10, wherein the monitoring assembly further comprises:

a load coupled to the bandpass filter and the signal processor, the load absorbing the reflected RF power at the second harmonic of the fundamental frequency; and

a second multiplexer coupled to the highpass filter, the second multiplexer comprising a plurality of outputs, each output passing reflected RF power at a harmonic frequency above the second harmonic frequency to the signal processor and attenuating reflected RF power at the other harmonic frequencies.

13. A plasma processing system comprising:

chamber enclosing a plasma region;

plasma generating component disposed in the chamber in communication with the plasma region;

source of RF power having at least one fundamental frequency; and

monitoring assembly comprising:

a harmonic multiplexer disposed in energy-receiving communication with the system component, and

a signal processor coupled to the harmonic multiplexer, wherein a first path in the multiplexer is used to provide RF power from a RF source to the plasma generating component in the chamber, the first path comprising a matching network coupled between the RF source and the plasma generating component, and wherein a second path in the multiplexer is used to monitor RF power reflected from the chamber, the second path comprising a filter assembly coupled between the plasma generating assembly and the signal processor.

14. The plasma processing system as claimed in claim 13, wherein the RF source provides RF power at a fundamental frequency and the filter assembly comprises a plurality of band pass filters, each bandpass filter passing reflected RF power at one harmonic of the fundamental frequency and attenuating reflected RF power at the fundamental frequency and other harmonic frequencies.

15. A monitoring assembly for monitoring a plasma process in a plasma processing chamber, the monitoring assembly comprising:

a harmonic multiplexer adapted to communicate energy to and from the plasma processing chamber; and

a signal processor coupled to the harmonic multiplexer, wherein a first path in the multiplexer comprises a matching network adapted to provide energy to the plasma processing chamber, and wherein a second path in the multiplexer comprises a filter assembly connected to the signal processor and adapted to receive reflected energy from the plasma processing chamber.

16. The monitoring assembly as claimed in claim 15, wherein the filter assembly comprises a plurality of band pass filters, each bandpass filter passing reflected RF power at one harmonic of a fundamental frequency and attenuating reflected RF power at the fundamental frequency and other harmonic frequencies.

17. A method for operating a processing chamber in a plasma processing system, the method comprising:

creating a plasma in the processing chamber;

measuring the harmonic signals present in the processing chamber with a monitoring assembly comprising a harmonic multiplexer and a signal processor;

comparing at least one measured harmonic signal with a reference signal; and

modifying the at least one measured harmonic signal.

18. The method as claimed in claim 17, wherein the creating a plasma comprises:

supplying a process gas to a plasma region in the processing chamber; and

supplying RF power at a fundamental frequency to the plasma region in order to create an RF electromagnetic field which interacts with the process gas to create a plasma that contains electromagnetic energy components at frequencies that are harmonics of the fundamental frequency.

19. The method as claimed in claim 17, wherein the harmonic multiplexer comprises a matching network and at least one filter element in energy receiving communication with the plasma, a filter element having a frequency dependent transmission characteristic such that the filter element passes electrical energy at a frequency higher than the fundamental frequency and attenuates electrical energy at the fundamental frequency.

20. The method as claimed in claim 19, wherein the filter elements are coupled to a transmission line supplying the RF power to the plasma.

21. The method as claimed in claim 19, wherein the modifying the at least one measured harmonic signal comprises at least one of changing the process gas, changing the process time, changing the process rate, changing the RF power, and tuning a filter element.

22. The method as claimed in claim 17, wherein the measuring of the harmonic signals comprises:

down converting the harmonic signals; and

analyzing the down converted signals to obtain information regarding at least one of: absolute magnitudes of the harmonics signals, relative magnitudes of harmonics signals, relative magnitudes of harmonic signals in reference to the fundamental signal, absolute phase of the harmonics, relative phase relationship between harmonics, and relative phase relationship of the harmonics signals in reference to the fundamental frequency.

23. The method as claimed in claim 22, wherein the analyzed signals are used to indicate at least one of the quality of an etching process, etch uniformity, etch rate, endpoint of a step, and endpoint of a process.